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So You've Deployed Kubernetes Everywhere, Now What?

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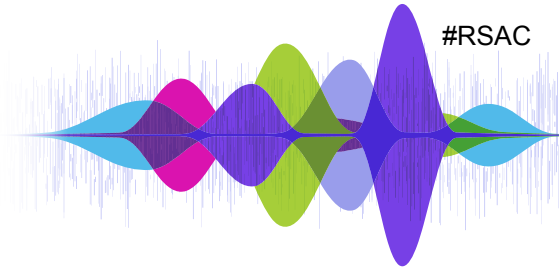

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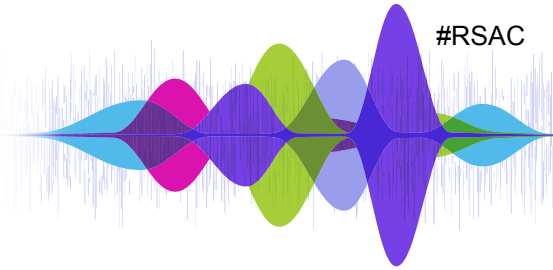
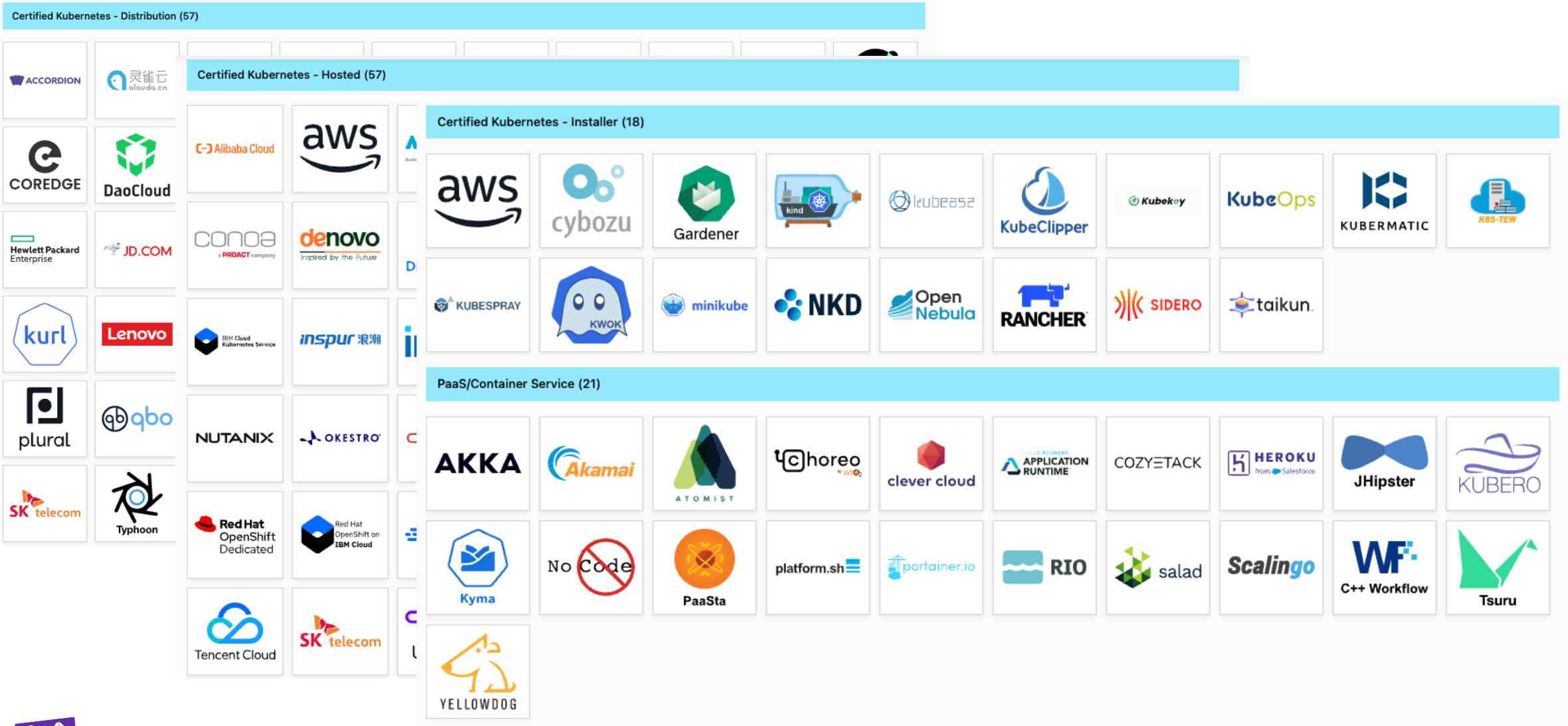


Introduction & Whom

- Senior security researcher and advocate at Datadog
- ~25 years in Information/IT/Cyber security
- Focusing on container security for ~9 years
- Maintainer of CIS Benchmarks for Docker and Kubernetes
- Work in the Kubernetes project including SIG-Security

Basic
Concepts

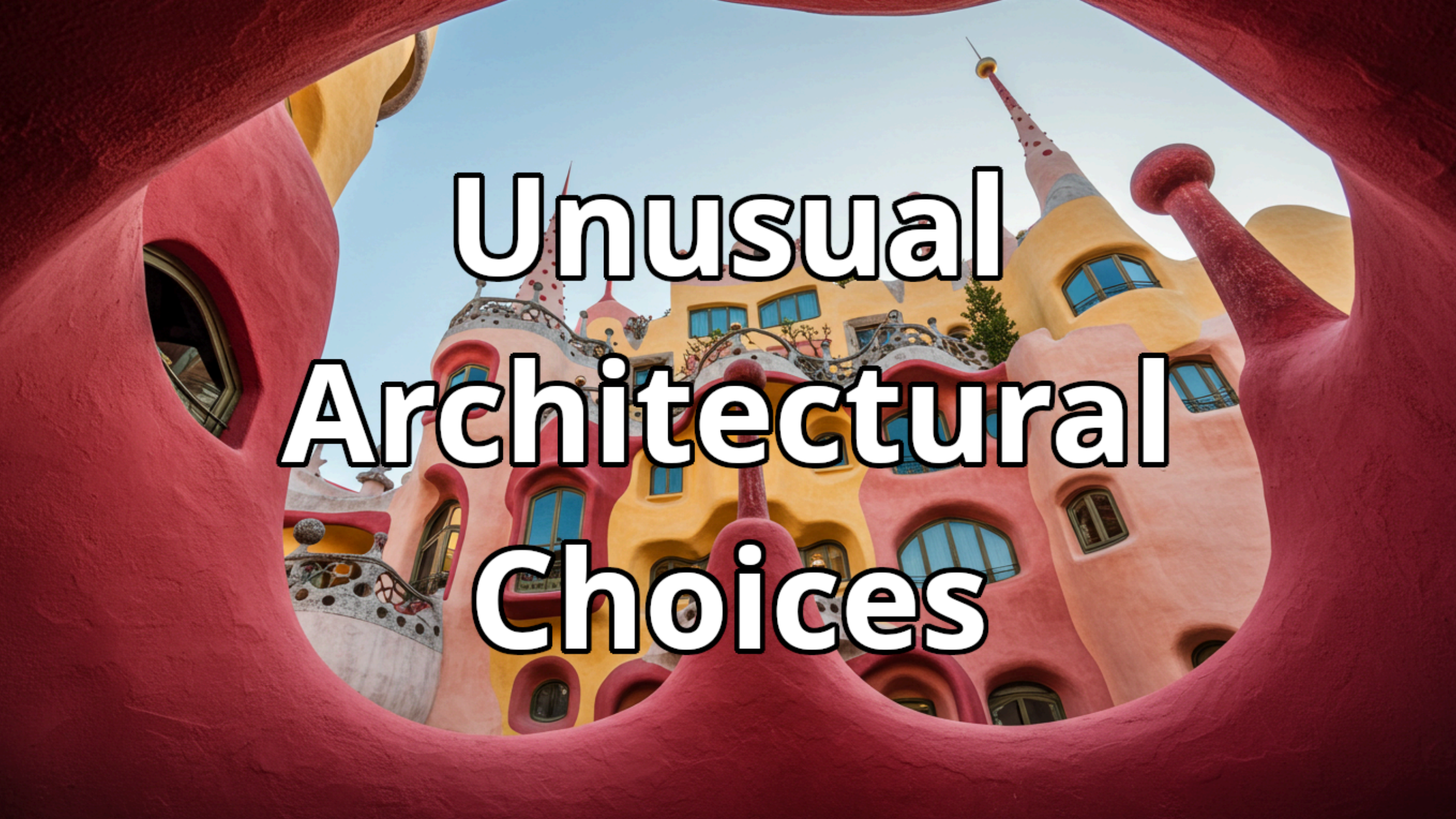
Distribution Variance



Managed
Kubernetes

Unmanaged
Kubernetes

Plugins


Unusual
Architectural
Choices

Flexible Authentication

- Kubernetes clusters can have one or more authentication providers
- Users can authenticate with any of them
- Most (production) clusters will use an external authentication source
- However internal sources are still present

No User Database

- Kubernetes does not have a user database!
  - Need to audit external authentication providers to know who has creds
- But, we have internal authentication mechanisms
  - For client certificates there is no persistent record of issued credentials or valid users
  - For service account tokens, there's a record of what valid accounts are but not issued credentials

Irrevocable Credentials

- Client certificates & service account tokens cannot be directly revoked
  - Rotate the CA key for the whole cluster for client certs
  - Delete the bound object for service accounts
- Credentials can have long lifetimes
- It’s possible to create new credentials for system accounts

Attack of the Clones

- With privileged access it's easy to clone system accounts using client certs or service accounts
- Provides hard to detect back door access to clusters
- Credentials often valid for years

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Flexible Authorisation

- Similar to authentication, authorisation is flexible
- In practice rights will be the union of all authorisers
- Managed clusters will generally have 2+ authorisers.

RBAC is just String Matching

- Whilst most people think of the Kubernetes API as being CRUD
- Any other verbs can exist
- RBAC works by matching strings
- No registry of objects & verbs

Auditing Access

- A combination of these two issues makes it hard to audit rights to clusters
- Many Kubernetes tools only cover RBAC
- Few (no?) tools can create a unified view of effective rights

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Create Pod == Root on Nodes by Default

- Kubernetes is distributed remote command execution as a service
- Without additional restrictions this means users who can create workloads can be root on the host
- Standard functionality, no hacks needed!

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Kubernetes API Server is a Proxy Server

- This is intended functionality
  - Allows for access to nodes and workloads without additional tools
- Essentially “SSRF as a service” for users with the correct rights
  - Restrictions on target address can be bypassed by known techniques
- Important to consider your threat model here

Security
Sharp Edges

System:masters Bypasses All Authorisation Checks

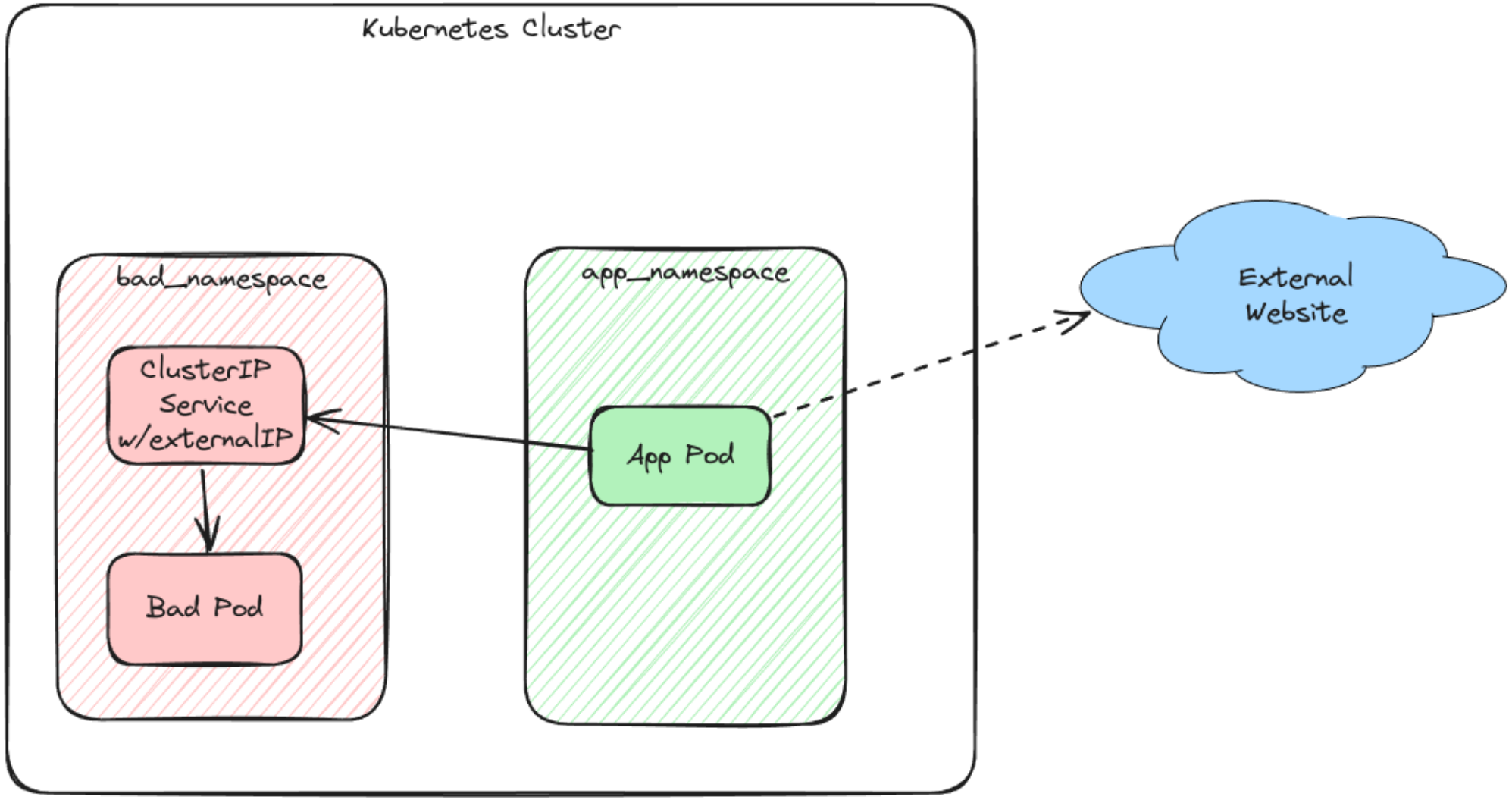
- system:masters is a group name hardcoded into Kubernetes
- Bypasses ALL authorisation checks
- Requests are not even sent to external authorisers
- Commonly used in initial accounts when clusters are setup

Kubelet API Bypasses Audit + Admission Control

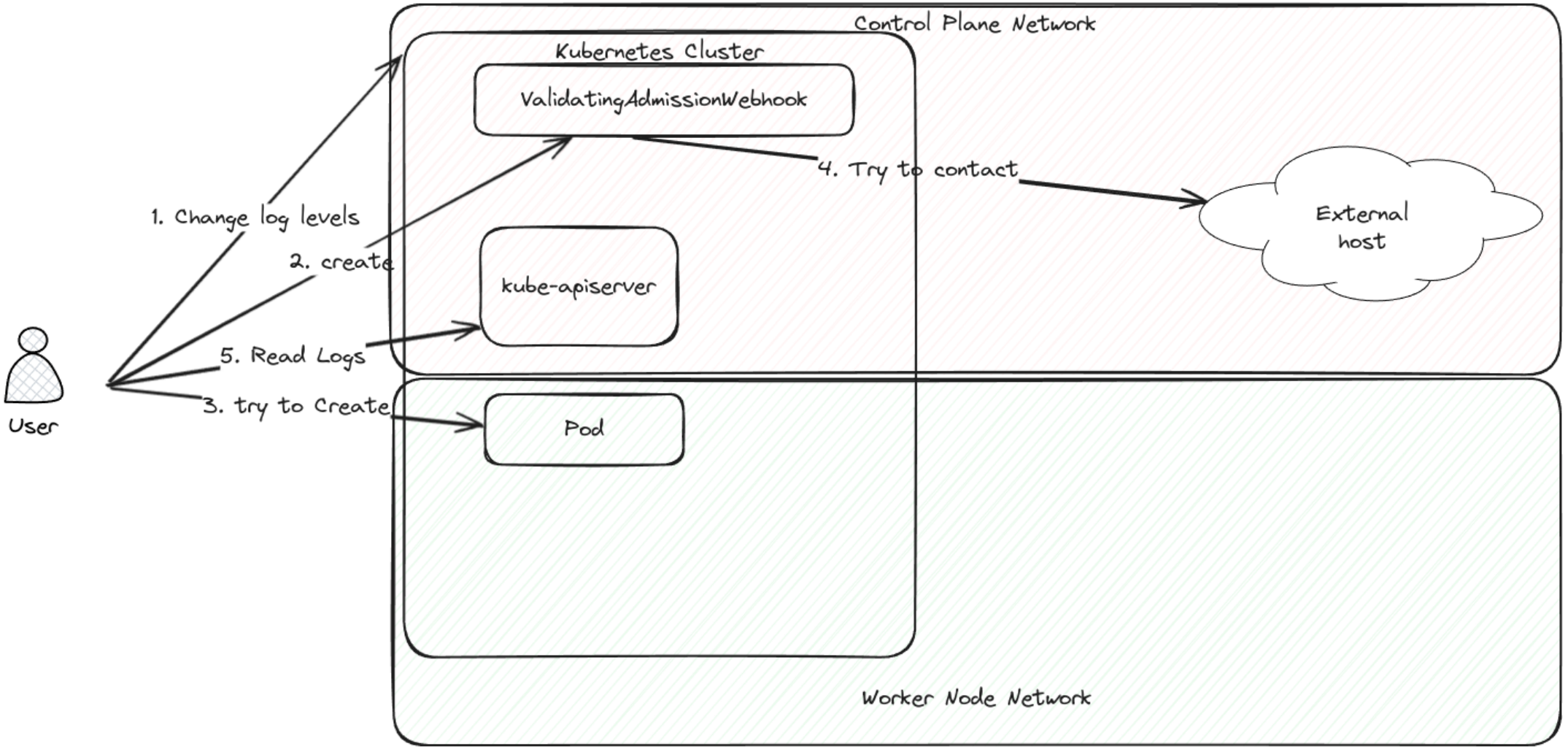
- The Kubelet (node agent) has its own API on 10250/TCP
- Supports command execution in every container on a host (amongst other things)
- No audit logging
- No admission control
- Access governed by Kubernetes RBAC (node/proxy)
  - Cluster privileged users automatically get access

The
Unpatchable
Four

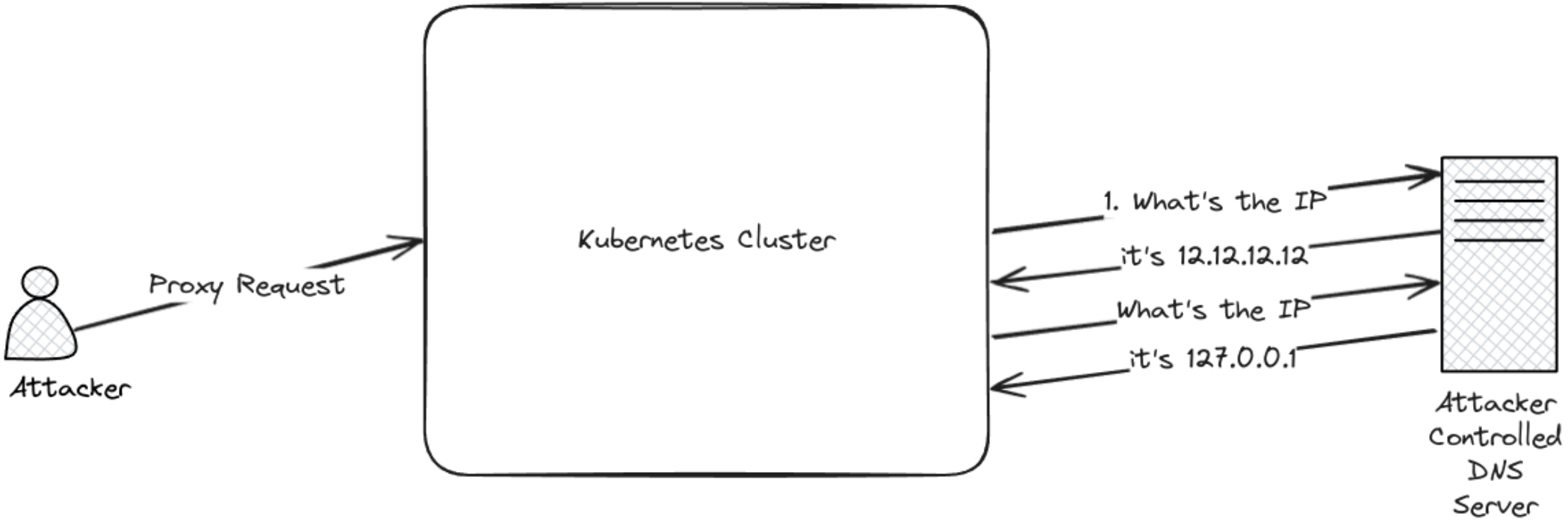
CVE-2020-8554



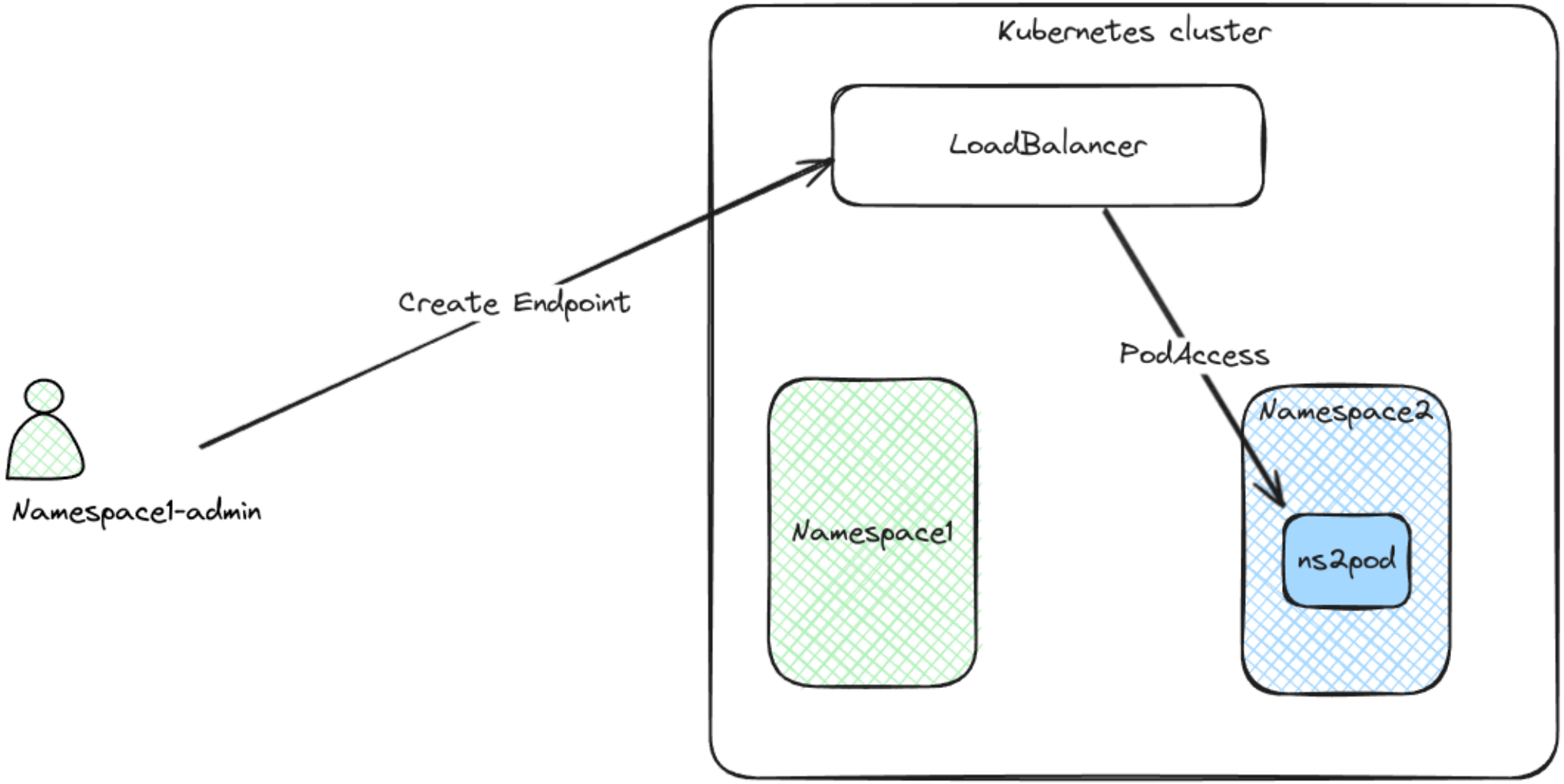
CVE-2020-8561



CVE-2020-8562

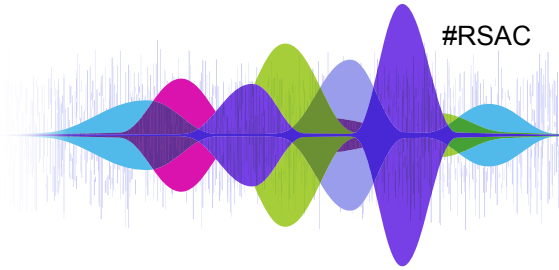


CVE-2021-25740



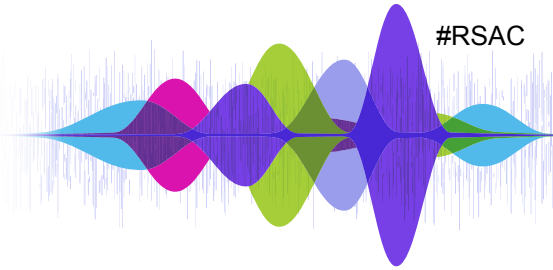
A Small Selection of Cloud Provider Defaults

- Internet accessible by default
- GKE Read-only Kubelet
- GKE system:authenticated is *everyone*
- AKS initial system:masters credential
- EKS Kube-proxy bound to all interfaces



“Apply” Slide

- Limit cluster exposure
- Enable Kubernetes audit logging
- Understand your cluster threat model
- Ensure appropriate visibility of AuthN and AuthZ configurations
- Ensure admission control restrictions are place for all users
- Have alerting in place for key attacks



Summary

- Kubernetes security can be a bit … complex
- It’s important to understand its architecture and how it fits in with your threat model
- There are quite a few security sharp corners to be aware of

Resources

- Datadog Security Labs - https://securitylabs.datadoghq.com/
- Security Labs Youtube - https://www.youtube.com/watch?v=jTswj4CS4IA&list=PLdh-RwQzDsaNWBex2I09OFLCph7I_KnQE
- Personal blog - https://raesene.github.io/

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